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100806_01US1.ST25.txt
SEQUENCE LISTING

<110> Actino Drug Pharmaceuticals GmbH
<120> Method of modifying peptide synthetases such that they can
N-methylate their substrate amino acids
<130> 100806.01US1
<140> US 10/018,113
<141> 2001-12-14
<150> DE 199 28 31.3-41
<151> 1999-06-16
<150> PCT/DE00/01950
<151> 2000-06-15
<160> 78
<170> PatentIn version 3.2
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 20 25 30

Glu Asp His Met Lys Glu Lys Tyr Leu Cys Ala Tyr Met Val Thr Glu
 35 40 45

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20 25 30

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35 40 45

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Pro Asp Glu Gln Gly Asn Leu Glu Val Cys Ala Tyr Val Val Gln Lys
35 40 45

Pro Gly Ser Glu Phe Ala Pro Ala Gly Leu Arg Glu His Ala Ala Arg
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Gln Leu Pro Asp Tyr Met Val Pro Ala Tyr Phe Thr Glu Val Thr Glu
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Ser Ala Asp Ile Glu Ala Leu Lys Ser Ala Leu Lys Glu Thr Leu Pro
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Asp Tyr Met Ile Pro Ala Phe Trp Val Thr Leu Asn Glu Leu Pro
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Lys Asn Lys Ala Asp Glu Asn Glu Ile Cys Ala Tyr Phe Thr Ala Asp
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Ser Glu Gly Gly Leu Gln Glu Leu Cys Ala Tyr Tyr Thr Ser Asp Gln
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Asp Ile Glu Lys Ala Glu Leu Arg Tyr Gln Leu Ser Leu Thr Leu Pro
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20 25 30

Lys Asp Lys Gly Gly Asn Thr Ala Ile Ala Ala Tyr Val Thr Pro Glu
35 40 45

Thr Ala Asp Ile Glu Ala Leu Lys Ser Thr Leu Lys Glu Thr Leu Pro
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Asp Tyr Met Ile Pro Ala Phe Trp Val Thr Leu Asn Glu Leu Pro
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Gln Leu Gln Glu Tyr Pro Gly Val Lys Asp Ala Val Val Val Ala Asp
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Arg His Glu Ser Gly Asp Ala Ser Ile Asn Ala Tyr Leu Val Asn Arg
35 40 45

Thr Gln Leu Ser Ala Glu Asp Val Lys Ala His Leu Lys Lys Gln Leu
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Pro Ala Tyr Met Val Pro Gln Thr Phe Thr Phe Leu Asp Glu Leu Pro
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Arg Leu Leu Asn His Pro Ala Ile Lys Glu Ala Val Val Ile Asp Arg
20 25 30

Ala Asp Glu Thr Gly Gly Lys Phe Leu Cys Ala Tyr Val Val Leu Gln
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Gln Asp Asp Arg Gly Asp Ser Tyr Leu Ala Ala Tyr Val Thr Gly Lys
35 40 45

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Pro Ala Tyr Met Val Pro Thr Tyr Leu Ile Gln Leu Asp Ala Phe Pro
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35 40 45

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Thr Leu Leu Gln His Glu Ala Val Lys Ala Val Val Val Met Ala Arg
Page 10

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35 40 45

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Pro Ser Tyr Met Ile Pro Ala His Phe Val Gln Leu Asp Gln Leu Pro
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Glu Asp Arg Gly Gln Glu Lys Glu Leu Cys Ala Tyr Val Val Ala Asp
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His Lys Leu Asp Thr Ala Glu Leu Arg Ala Asn Leu Leu Lys Glu Leu
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20 25 30

Asp Asp Asp Ala Thr Ala Gly Ser Tyr Leu Cys Ala Tyr Phe Val Ala
35 40 45

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20 25 30

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35 40 45

Ile Gly Ala Gly Glu Lys Asn Ser His Ile Leu Asp Gln Arg Ala Thr
50 55 60

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Page 14

35

40

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Arg Glu Ile Ser Leu Asp Glu Leu Lys Gly Phe Leu Gly Glu Lys Leu
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Pro

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Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Thr Gly Glu Ile Glu Thr
1 5 10 15

Lys Leu Leu Glu Asn Gln Asn Ile Ser Glu Ala Val Val Ile Asp Arg
20 25 30

Glu Asp Lys Lys Gly His Lys Tyr Leu Cys Ala Tyr Ile Val Ala Arg
35 40 45

Ala Lys Thr Asn Thr Asn Glu Leu Arg Glu Tyr Leu Ser Asp His Leu
50 55 60

Pro Asp Tyr Met Leu Pro Ser Tyr Phe Ile Gln Ile Asn Lys Met Pro
65 70 75 80

<210> 29
<211> 80
<212> PRT
<213> Bacillus licheniformis

<220>
<223> BACC_1 Bacitracin Synthetase C Pos: 855 to 934
<400> 29

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Leu Gly Glu Ile Glu Ser
1 5 10 15

Arg Leu Glu Met His Glu Asp Ile Asn Glu Thr Ile Val Thr Val Arg
20 25 30

Glu Asp Glu Glu Ser Arg Pro Tyr Ile Cys Ala Tyr Ile Thr Ala Asn
35 40 45

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Arg Glu Ile Ser Leu Asp Glu Leu Lys Gly Phe Leu Gly Glu Lys Leu
50 55 60

Pro Glu Tyr Met Ile Pro Ala Tyr Phe Val Lys Met Asp Lys Leu Pro
65 70 75 80

<210> 30
<211> 80
<212> PRT
<213> Bacillus licheniformis

<220>
<223> BACC_2 Bacitracin Synthetase C Pos: 1887 to 1966

<400> 30

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Leu Gly Glu Ile Glu Asn
1 5 10 15

Gln Leu Leu Lys Leu Asp Lys Ile Asp Glu Ala Ala Val Ile Ala Arg
20 25 30

Lys Asp Asp Asp His Ser Asp Tyr Leu Cys Ala Tyr Ile Val Ser Lys
35 40 45

Glu Asp Trp Thr Ser Thr Glu Ile Ser Glu Trp Leu Glu Lys Glu Leu
50 55 60

Pro His Tyr Met Ile Pro Ala Tyr Phe Val Arg Leu Asp Lys Leu Pro
65 70 75 80

<210> 31
<211> 80
<212> PRT
<213> Bacillus licheniformis

<220>
<223> BACC_3 Bacitracin Synthetase C Pos: 3392 to 3471

<400> 31

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Leu Gly Glu Ile Glu Asn
1 5 10 15

Gln Leu Leu Lys Ile Glu Gly Ile Asp Ala Ala Ala Val Met Ala Arg
20 25 30

Glu Asp Gln Ala Gly Gly Lys Tyr Leu Cys Ala Tyr Ile Val Ala Asp
35 40 45

Lys Ala Ala Gly Val Ala Asp Val Arg Lys Cys Leu Leu Lys Glu Leu
50 55 60

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Pro Asp Tyr Met Val Pro Ser Tyr Phe Val Lys Leu Asp Gln Leu Pro
65 70 75 80

<210> 32
<211> 80
<212> PRT
<213> Bacillus licheniformis

<220>
<223> BACC_4 Bacitracin Synthetase C Pos: 4435 to 4514

<400> 32

Gln Val Lys Val Arg Gly Tyr Arg Ile Glu Pro Glu Glu Ile Lys Asn
1 5 10 15

Arg Leu Leu Ala His Asp Asp Ile Lys Glu Ala Phe Ile Ala Ala Arg
20 25 30

Glu Asp His Lys Gly Ala Lys Gln Leu Cys Ala Tyr Phe Thr Ala Asp
35 40 45

Ala Glu Leu Pro Phe Glu Asp Ile Arg Thr Tyr Leu Met His Glu Leu
50 55 60

Pro Glu Tyr Met Ile Pro Ser Ser Phe Val Gln Ile Glu Lys Met Pro
65 70 75 80

<210> 33
<211> 76
<212> PRT
<213> Bacillus subtilis

<220>
<223> PPS1_1 Fengycin Synthetase 1 Pos: 860 to 935

<400> 33

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Pro Gly Glu Ile Glu Ala
1 5 10 15

Ala Leu Arg Ser Ile Glu Gly Val Arg Glu Ala Ala Val Thr Val Arg
20 25 30

Thr Asp Ser Gly Glu Pro Glu Leu Cys Ala Tyr Val Glu Gly Leu Gln
35 40 45

Arg Asn Glu Val Arg Ala Gln Leu Gln Arg Leu Leu Pro Gly Tyr Met
50 55 60

Val Pro Ala Tyr Met Ile Glu Met Glu Gln Trp Pro
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65

70

<210> 34
<211> 79
<212> PRT
<213> Bacillus subtilis

<220>
<223> PPS1_2 Fengycin Synthetase 1 Pos: 1904 to 1982
<400> 34

Gln Val Lys Ile Asn Gly Tyr Arg Ile Glu Thr Glu Glu Ile Glu Ser
1 5 10 15

Val Leu Leu Gln Thr Gly Leu Val Arg Glu Ala Ala Val Ala Val Gln
20 25 30

His Asp Lys Asn Gly Gln Ala Gly Leu Ala Ala Tyr Ile Val Pro Ser
35 40 45

Asp Val Asn Thr Asn Ala Leu Arg Ala Ala Leu Thr Lys Glu Leu Pro
50 55 60

Ala Tyr Met Ile Pro Ala Tyr Leu Ile Pro Leu Val Asn Met Pro
65 70 75

<210> 35
<211> 80
<212> PRT
<213> Bacillus subtilis

<220>
<223> PPS2_1 Fengycin Synthetase 2 Pos: 860 to 940
<400> 35

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Leu Arg Glu Ile Glu Thr
1 5 10 15

Val Leu Arg Gln Ala Pro Gly Val Lys Glu Ala Ala Val Leu Ala Arg
20 25 30

Asp Val Ser Ala Glu Glu Lys Glu Leu Val Ala Tyr Ile Val Pro Glu
35 40 45

Lys Gly Asn Ser Leu Pro Asp Leu Tyr Gln His Leu Ala Gly Thr Leu
50 55 60

Pro Ser Tyr Met Ile Pro Ala Ser Ile Ile Asn Ile Ser Gln Met Pro
65 70 75 80

<210> 36
 <211> 82
 <212> PRT
 <213> Bacillus subtilis

<220>
 <223> PPS2_2 Fengycin Synthetase 2 Pos: 1899 to 1980

<400> 36

Gln Val Lys Val Arg Gly His Arg Ile Glu Leu Gly Glu Ile Gln Ala
 1 5 10 15

Ala Leu Leu Gln Tyr Pro Met Ile Lys Glu Ala Ala Val Ile Thr Arg
 20 25 30

Ala Asp Glu Gln Gly Gln Thr Ala Ile Tyr Ala Tyr Met Val Ile Lys
 35 40 45

Asp Gln Gln Ala Ala Asn Ile Ser Asp Ile Arg Thr Tyr Leu Lys Asn
 50 55 60

Ala Leu Pro Asp Phe Met Leu Pro Ala Arg Met Ile Gln Ile Asp Ser
 65 70 75 80

Ile Pro

<210> 37
 <211> 76
 <212> PRT
 <213> Bacillus subtilis

<220>
 <223> PPS3_1 Fengycin Synthetase 3 Pos: 866 to 941

<400> 37

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Pro Gly Glu Ile Glu Ala
 1 5 10 15

Ala Leu Arg Ser Ile Glu Gly Val Arg Glu Ala Ala Val Thr Val Arg
 20 25 30

Thr Asp Ser Gly Glu Pro Glu Leu Cys Ala Tyr Val Glu Gly Leu Gln
 35 40 45

Arg Asn Glu Val Arg Ala Gln Leu Gln Arg Leu Leu Pro Gly Tyr Met
 50 55 60

Val Pro Ala Tyr Met Ile Glu Met Glu Gln Trp Pro
 65 70 75

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<210> 38
 <211> 80
 <212> PRT
 <213> Bacillus subtilis

<220>
 <223> PPS3_2 Fengycin Synthetase 3 Pos: 1899 to 1978

<400> 38

Gln Val Lys Val Arg Gly Tyr Arg Val Glu Leu Gly Glu Ile Glu Thr
 1 5 10 15

Ala Leu Arg Gln Ile Asp Gly Val Lys Glu Ala Ala Val Leu Ala Arg
 20 25 30

Thr Ala Gln Thr Gly Ser Lys Glu Leu Phe Gly Tyr Ile Ser Val Lys
 35 40 45

Ala Gly Thr Asn Ala Glu Gln Val Arg Ser Leu Leu Ala Arg Ser Leu
 50 55 60

Pro Asn Tyr Met Ile Pro Ala Tyr Ile Ile Glu Met Glu Thr Leu Pro
 65 70 75 80

<210> 39
 <211> 80
 <212> PRT
 <213> Bacillus subtilis

<220>
 <223> PPS4_1 Fengycin Synthetase 4 Pos: 861 to 940

<400> 39

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Pro Gln Glu Ile Glu Val
 1 5 10 15

Thr Leu Met Asn His Pro Asp Ile Ser Glu Ala Ala Ile Leu Ile Trp
 20 25 30

Gln Asp Gln Asn Gly Glu His Glu Leu Cys Ala Tyr Tyr Cys Ser Val
 35 40 45

Gln Lys Leu Asn Thr Ile Asp Leu Arg Ser Tyr Met Ala Ser Glu Leu
 50 55 60

Pro Glu Tyr Met Ile Pro Ala Lys Trp Ile Trp Val Asp Ser Ile Pro
 65 70 75 80

<210> 40
 <211> 76

<212> PRT
 <213> Bacillus subtilis

<220>
 <223> PPS4_2 Fengycin Synthetase 4 Pos: 1896 to 1971

<400> 40

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Pro Gly Glu Ile Glu Ala
 1 5 10 15

Ala Leu Arg Ser Ile Glu Gly Val Arg Glu Ala Ala Val Thr Val Arg
 20 25 30

Thr Asp Ser Gly Glu Pro Glu Leu Cys Ala Tyr Val Glu Gly Leu Gln
 35 40 45

Arg Asn Glu Val Arg Ala Gln Leu Glu Arg Leu Leu Pro Gly Tyr Met
 50 55 60

Val Pro Ala Tyr Met Ile Glu Met Glu Gln Trp Pro
 65 70 75

<210> 41
 <211> 80
 <212> PRT
 <213> Bacillus subtilis

<220>
 <223> PPS4_3 Fengycin Synthetase 4 Pos: 2928 to 3007

<400> 41

Gln Val Lys Ile Arg Gly Tyr Arg Val Glu Thr Lys Glu Ile Glu Ser
 1 5 10 15

Val Ile Arg Cys Ile Lys Gly Val Lys Asp Ala Ala Val Val Ala His
 20 25 30

Val Thr Ala Ser Gly Gln Thr Glu Leu Ser Ala Tyr Val Val Thr Lys
 35 40 45

Pro Gly Leu Ser Thr Asn Ala Val Arg Ser Glu Leu Gln Asn Lys Leu
 50 55 60

Pro Val Phe Met His Pro Ala Phe Ile Glu Lys Leu Asp Ser Leu Pro
 65 70 75 80

<210> 42
 <211> 82
 <212> PRT
 <213> Bacillus licheniformis

<220>

<223> LICA_1 Lichenysin Synthetase A Pos: 864 to 943

<400> 42

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Leu Gly Glu Ile Glu Ser
 1 5 10 15

Val Leu Gln Gly Ala Pro Ala Val Gly Lys Ala Val Val Leu Ala Arg
 20 25 30

Pro Glu Thr Gly Gly Ser Leu Glu Val Cys Ala Tyr Val Val Pro Lys
 35 40 45

Gln Ser Gly Glu Ile His Leu Gln Gly Leu Arg Glu His Leu Ser Lys
 50 55 60

His Leu Pro Asp Tyr Met Ile Pro Ser His Phe Val Glu Leu Asp Glu
 65 70 75 80

Ile Pro

<210> 43

<211> 80

<212> PRT

<213> Bacillus licheniformis

<220>

<223> LICA_2 Lichenysin Synthetase A Pos: 1905 to 1984

<400> 43

Gln Val Lys Ile Arg Gly Gln Arg Ile Glu Leu Gly Glu Ile Glu His
 1 5 10 15

His Leu Val Thr His Glu Met Val Gln Glu Ala Ala Val Leu Ala Val
 20 25 30

Asp Thr Gly Lys Arg Asp Gln Met Ile Cys Ala Tyr Phe Thr Ala Asp
 35 40 45

Gln Glu Leu Ser Ser Glu Glu Leu Arg Arg Tyr Ala Ala Glu Gly Leu
 50 55 60

Pro Gly Tyr Met Ile Pro Ser Val Phe Met Gln Leu Gln Glu Leu Pro
 65 70 75 80

<210> 44

<211> 80

<212> PRT

<213> Bacillus licheniformis

<220>

<223> LICA_3 Lichenysin Synthetase A Pos: 2932 to 3011

<400> 44

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Leu Ser Glu Ile Glu Val
 1 5 10 15

Gln Leu Ala Arg Leu Ser Glu Val Gln Glu Ala Val Val Thr Asp Ile
 20 25 30

Glu Asp Ala Cys Gly Asn Lys Ala Leu Cys Gly Tyr Val Val Ala Asn
 35 40 45

Glu Gln Leu Asp Thr Glu Ser Leu Ala Arg Lys Leu Ala Gln Thr Leu
 50 55 60

Pro Asp Tyr Met Val Pro Ser Phe Trp Val Gln Leu Lys Glu Leu Pro
 65 70 75 80

<210> 45

<211> 78

<212> PRT

<213> Bacillus licheniformis

<220>

<223> LICB_1 Lichenysin Synthetase B Pos: 859 to 936

<400> 45

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Leu Gly Glu Val Glu Ala
 1 5 10 15

Ala Leu Ala Arg Leu Glu Gly Ile Ser Glu Ala Ala Ala Val Ile Arg
 20 25 30

Glu Asn Asn Ala Gly Glu Asn Glu Ile Cys Ala Tyr Tyr Ala Gly Ala
 35 40 45

Arg Pro Ala Ala Gln Leu Arg Thr Glu Leu Ser Arg Ser Leu Pro Glu
 50 55 60

Tyr Met Ile Pro Ala His Leu Ile Glu Leu Asp Ser Met Pro
 65 70 75

<210> 46

<211> 80

<212> PRT

<213> Bacillus licheniformis

<220>

<223> LICB_2 Lichenysin Synthetase B Pos: 1900 to 1979

C1
Cmt

<400> 46

Gln Val Lys Ile Arg Gly Tyr Arg Ile Glu Leu Lys Glu Ile Glu Glu
 1 5 10 15

Ala Phe Asn Gly Leu Asp Asp Ile Glu Arg Ala Ile Val Leu Ser Phe
 20 25 30

Thr Thr Asp Ser Gly Leu Asp Glu Leu Cys Ala Tyr Ile Gln Ala Lys
 35 40 45

Arg Gln Leu Pro Val Ser Glu Leu Arg Glu Arg Leu Ser Glu Arg Leu
 50 55 60

Pro Ser Tyr Met Ile Pro Ser Tyr Phe Val Thr Val Asp Lys Met Pro
 65 70 75 80

<210> 47

<211> 80

<212> PRT

<213> Bacillus licheniformis

<220>

<223> LICB_3 Lichenysin Synthetase B Pos: 2932 to 3011

<400> 47

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Leu Ser Glu Ile Glu Val
 1 5 10 15

Gln Leu Ala Arg Leu Ser Glu Val Gln Glu Ala Val Val Thr Asp Ile
 20 25 30

Glu Asp Ala Cys Gly Asn Lys Ala Leu Cys Gly Tyr Val Val Ala Asn
 35 40 45

Glu Gln Leu Asp Thr Glu Ser Leu Ala Arg Lys Leu Ala Gln Thr Leu
 50 55 60

Pro Asp Tyr Met Val Pro Ser Phe Trp Val Gln Leu Asp Glu Leu Pro
 65 70 75 80

<210> 48

<211> 82

<212> PRT

<213> Bacillus licheniformis

<220>

<223> LICC_1 Lichenysin Synthetase C Pos: 872 to 953

<400> 48

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Gln Val Lys Ile Arg Gly His Arg Ile Glu Leu Gly Glu Ile Glu Glu
1 5 10 15

Glu Leu Met Arg Cys Gln Gly Val Lys Glu Ala Val Val Ile Ala Lys
20 25 30

Lys Arg Gly Asn Gly Asp Ala Ala Leu Thr Ala Tyr Val Val Pro Val
35 40 45

Arg Gly Ala Val Val Ser Asn Glu Glu Val Arg Arg Gln Leu Ala Arg
50 55 60

Asn Leu Pro Ala Tyr Met Val Pro Asp Ala Tyr Ile Met Leu Glu Glu
65 70 75 80

Leu Pro

<210> 49
<211> 82
<212> PRT
<213> Streptomyces pristinaespiralis

<220>
<223> SNBC_1 Pristinamycin I Synthetase C Pos: 841 to 922

<400> 49

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Leu Gly Glu Ile Glu Asn
1 5 10 15

Val Leu Ala Thr His Pro Gly Val Ala Gln Ala Ala Ala Val Val Arg
20 25 30

Glu Asp Arg His Gly Asp Leu Arg Leu Ala Ala Tyr Ala Val Pro Thr
35 40 45

Pro Gly Thr Glu Pro Asp Val Ala Gly Trp Arg Ala Leu Leu Ala Gly
50 55 60

Gln Leu Pro Ala His Ser Leu Pro Ala Ser Phe Thr Leu Leu Ala Ala
65 70 75 80

Leu Pro

<210> 50
<211> 81
<212> PRT
<213> Streptomyces pristinaespiralis

<220>

<223> SNBD_1 Pristinamycin I Synthetase D Pos: 859 to 939

<400> 50

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Ala
 1 5 10 15

Ala Leu Thr Asp Leu Pro Ala Val Ala Arg Ala Ala Val Val Val Arg
 20 25 30

Glu Asp Arg Pro Gly Asp Lys Arg Leu Val Ala Tyr Ala Val Pro Ala
 35 40 45

Gly Glu Gly Leu Asp Ala Ala Ala Val Arg Ser Arg Leu Ala Arg Thr
 50 55 60

Leu Pro Asp Phe Met Val Pro Ala Ala Ile Val Ala Leu Asp Ala Leu
 65 70 75 80

Pro

<210> 51

<211> 75

<212> PRT

<213> Streptomyces pristinaespiralis

<220>

<223> SNBD_3 Pristinamycin I Synthetase D Pos: 3340 to 3415

<400> 51

Gln Val Lys Ile Arg Gly Phe Arg Val Glu Pro Gly Glu Val Glu Ala
 1 5 10 15

Ala Leu Thr Ala His Pro Arg Ile Thr Gln Ala Ala Val Leu Ala His
 20 25 30

Gly Asp Arg Leu Val Ala Tyr Val Val Thr Thr Ala Asp Arg Asp Leu
 35 40 45

Thr Gly Val Arg Glu His Leu Ala Ala Arg Leu Pro Asp Phe Met Val
 50 55 60

Pro Thr Ala Tyr Val Arg Leu Glu Ala Leu Pro
 65 70 75

<210> 52

<211> 83

<212> PRT

<213> Streptomyces pristinaespiralis

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<220>

<223> SNBD_4 Pristinamycin I Synthetase D Pos: 4398 to 4480

<400> 52

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Thr
1 5 10 15

Ala Leu Ala Ala His Pro Asp Val Thr Arg Ala Ala Val Val Ala Arg
20 25 30

Pro Gly Arg Ala Gly Asp Lys Val Leu Val Ala Tyr Leu Val Thr Ala
35 40 45

Pro Asp Ala Gly Asp Thr Thr Ala Glu Gln Leu Arg Ala Gly Leu Glu
50 55 60

Thr Gln Leu Pro Asp Tyr Met Val Pro Ala Ala Phe Val Ala Leu Pro
65 70 75 80

Ala Leu Pro

<210> 53

<211> 82

<212> PRT

<213> Streptomyces pristinaespiralis

<220>

<223> SNBC_2 Pristinamycin I Synthetase C Pos: 1900 to 1981

<400> 53

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Leu Gly Glu Ile Glu Ser
1 5 10 15

Val Leu Gly Ala His Pro Gly Ile Ala Gln Ser Ala Val Leu Val Arg
20 25 30

Glu Asp Arg Pro Gly Asp Lys Arg Leu Val Ala Tyr Val Val Pro Ala
35 40 45

Pro Gly Ala Thr Ala Asp Ala Thr Val Leu Arg Arg His Val Ala Ala
50 55 60

Ala Leu Pro Asp Tyr Met Val Pro Ala Ala Phe Val Pro Leu Asp Ala
65 70 75 80

Leu Pro

C1
Cont

<210> 54
 <211> 80
 <212> PRT
 <213> Streptomyces chrysomallus

<220>
 <223> ACMB_1 Actinomycin Synthetase II Pos: 875 to 954
 <400> 54

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Leu Gly Glu Val Glu Ala
 1 5 10 15

Ala Leu Leu Ala His Pro Asp Val Glu Gln Ala Thr Val Ile Val Arg
 20 25 30

Glu Asp Arg Pro Gly Asp Thr Arg Leu Val Ala Tyr Val Val Gly Arg
 35 40 45

Glu Ala Leu Arg Pro Glu Gln Val Arg Glu Phe Thr Arg Glu Arg Leu
 50 55 60

Pro Glu His Met Val Pro Ala Ala Val Val Gln Leu Glu Arg Leu Pro
 65 70 75 80

<210> 55
 <211> 80
 <212> PRT
 <213> Streptomyces chrysomallus

<220>
 <223> ACMB_2 Actinomycin Synthetase II Pos: 1924 to 2003
 <400> 55

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Asn
 1 5 10 15

Val Leu Thr Gly His Pro Ala Val Ala Gln Ala Ala Ile Leu Val Arg
 20 25 30

Glu Asp Gln Pro Gly Arg Pro Arg Leu Val Ala Tyr Val Val Ala Asp
 35 40 45

Gly Gly Thr Ala Pro Asp Gly Leu Arg Glu Ala Leu Arg Arg Arg Leu
 50 55 60

Pro Glu Tyr Met Val Pro Ser Ala Phe Val Val Leu Asp Arg Leu Pro
 65 70 75 80

<210> 56
 <211> 80

<212> PRT

<213> Streptomyces chrysomallus

<220>

<223> ACMC_1 Actinomycin Synthetase III Pos: 865 to 944

<400> 56

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Lys
 1 5 10 15

Val Leu Thr Asp His Pro Asp Ile Ala Gln Ala Ala Val Val Thr Arg
 20 25 30

Pro His Arg Pro Gly Asp Thr Arg Leu Val Ala Tyr Val Val Gly Arg
 35 40 45

Glu Ala Leu Arg Pro Glu Gln Val Arg Glu Phe Thr Arg Glu Arg Leu
 50 55 60

Pro Glu His Met Val Pro Ala Ala Val Val Gln Leu Glu Arg Leu Pro
 65 70 75 80

<210> 57

<211> 73

<212> PRT

<213> Streptomyces chrysomallus

<220>

<223> ACMC_2 Actinomycin Synthetase III Pos: 1922 to 1994

<400> 57

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Lys
 1 5 10 15

Val Leu Thr Asp His Pro Asp Ile Ala Gln Ala Ala Val Val Val Arg
 20 25 30

Glu Asp Gln Pro Gly Asp Ala Arg Leu Val Ala Tyr Val Val Thr Gly
 35 40 45

Gly Ser Ala Asp Ala Arg Asp Glu Gln Val Glu Gln Asp Gln Leu Asp
 50 55 60

Glu Trp Gln Asp Leu Tyr Asp Ser Val
 65 70

<210> 58

<211> 40

<212> PRT

<213> Streptomyces chrysomallus

<220>

<223> APMC_2 Actinomycin Synthetase III Pos: 2379 to 2418

<400> 58

Thr Asn Pro Ala Ala Gly Arg Gly Thr Ser Ala Leu Leu Thr Thr Leu
 1 5 10 15

Arg Glu His Ala Arg Thr His Leu Pro Asp Tyr Met Gln Pro Ser Ala
 20 25 30

Leu Val Pro Leu Asp Arg Leu Pro
 35 40

<210> 59

<211> 72

<212> PRT

<213> Streptomyces chrysomallus

<220>

<223> APMC_3 Actinomycin Synthetase III Pos: 3389 to 3460

<400> 59

Gln Val Lys Val Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Asn
 1 5 10 15

Val Leu Thr Asp His Pro Ala Val Ala Gln Ala Ala Val His Leu Asn
 20 25 30

Arg Asp Gln Pro Gly Asn Pro Arg Leu Val Ala Tyr Val Val Ala Asp
 35 40 45

Thr Ser Ala Pro Ser Ser Asp Val Asp Gln Gln His Gln Ile Gly Glu
 50 55 60

Trp Gln Asp Leu Tyr Asp Ser Leu
 65 70

<210> 60

<211> 40

<212> PRT

<213> Streptomyces chrysomallus

<220>

<223> APMC_3 Actinomycin Synthetase II Pos: 3837 to 3876

<400> 60

Thr Asn Pro Val Gly Ser Arg Gly Thr Ala Ala Leu Leu Thr Ala Leu
 1 5 10 15

Arg Glu His Ala Ala Ala Gln Leu Pro Asp Tyr Met Arg Pro Ala Ala
 20 25 30

Ile Val Pro Leu Asp Arg Leu Pro
35 40

<210> 61
<211> 74
<212> PRT
<213> Streptomyces pristinaespiralis

<220>
<223> SNBD_2 Pristinamycin I Synthetase D Pos: 1901 to 1974

<400> 61

Gln Val Lys Ile Arg Gly Phe Arg Ile Glu Pro Gly Glu Ile Glu Thr
1 5 10 15

Val Leu Thr Ala His Pro Ala Val Ala Ala Gly Ala Val Ile Ala Arg
20 25 30

Glu Asp Thr Pro Gly Asp Lys Gln Leu Val Ala Tyr Leu Thr Arg Asp
35 40 45

Thr Thr His His Ala Ala Pro Asp Gln Asp Leu Gly Thr Gly Gln Val
50 55 60

Asp Arg Trp Gln Gln Thr Tyr Asp Ser Leu
65 70

<210> 62
<211> 41
<212> PRT
<213> Streptomyces pristinaespiralis

<220>
<223> SNBD_2 Pristinamycin I Synthetase D Pos: 2331 to 2370

<400> 62

Ala Asn Asp Pro Ala Arg Ala Glu Gln Asp Ala Ala Leu Val Gly Glu
1 5 10 15

Leu Arg Asp Leu Val Ala Gln Arg Leu Pro Ala His Met Ala Pro Ala
20 25 30

Ala Tyr Val Leu Leu Asp Arg Leu Pro
35 40

<210> 63
<211> 73
<212> PRT
<213> Tolypocladium niveum

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<220>

<223> CYSA_2 Cyclosporine Synthetase Pos: 1976 to 2048

<400> 63

Gln Val Lys Val Arg Gly His Arg Ile Glu Leu Ala Glu Val Glu His
1 5 10 15

Ala Leu Leu Ser Ser Ala Gly Val His Asp Ala Val Val Val Ser Asn
20 25 30

Ser Gln Glu Asp Asn Gln Gly Val Glu Met Val Ala Phe Ile Thr Ala
35 40 45

Gln Asp Asn Glu Thr Leu Gln Glu Ala Gln Ser Ser Asn Gln Val Gln
50 55 60

Glu Trp Glu Ser His Phe Glu Thr Thr
65 70

<210> 64

<211> 41

<212> PRT

<213> Tolypocladium niveum

<220>

<223> CYSA_2 Cyclosporine Synthetase Pos: 2454 to 2494

<400> 64

Thr Asn Arg Pro Leu Gln Arg Val Glu Ser Arg Arg Ile Glu Ala Gln
1 5 10 15

Val Arg Glu Gln Leu Gln Val Leu Leu Pro Ala Tyr Met Ile Pro Ala
20 25 30

Arg Ile Val Val Leu Gln Asn Met Pro
35 40

<210> 65

<211> 71

<212> PRT

<213> Tolypocladium niveum

<220>

<223> CYSA_3 Cyclosporine Synthetase Pos: 3471 to 3540

<400> 65

Gln Val Lys Ile Arg Gly His Arg Ile Glu Pro Ala Glu Val Glu Tyr
1 5 10 15

Ala Leu Leu Ser His Asp Leu Val Thr Asp Ala Ala Val Val Thr His
20 25 30

Ser Gln Glu Asn Gln Asp Leu Glu Met Val Gly Phe Val Ala Ala Arg
35 40 45

Val Ala Asp Val Arg Glu Asp Glu Ser Ser Asn Gln Val Gln Glu Trp
50 55 60

Gln Thr His Phe Asp Ser Ile
65 70

<210> 66
<211> 41
<212> PRT
<213> Tolypocladium niveum

<220>
<223> CYSA_3 Cyclosporine Synthetase Pos: 3941 to 3981

<400> 66

Thr Asn His Pro Leu His Arg Ala Gln Ser Arg Arg Val Glu Arg Gln
1 5 10 15

Ile Arg Glu Arg Leu Gln Thr Leu Leu Pro Ala Tyr Met Ile Pro Ala
20 25 30

Gln Ile Met Val Leu Asp Lys Leu Pro
35 40

<210> 67
<211> 72
<212> PRT
<213> Tolypocladium niveum

<220>
<223> CYSA_4 Cyclosporine Synthetase Pos: 4960 to 5031

<400> 67

Gln Ile Lys Ile Arg Gly His Arg Ile Glu Pro Ala Glu Val Glu Gln
1 5 10 15

Ala Phe Leu Asn Asp Gly Phe Val Glu Asp Val Ala Ile Val Ile Arg
20 25 30

Thr Pro Glu Asn Gln Glu Pro Glu Met Val Ala Phe Val Thr Ala Lys
35 40 45

Gly Asp Asn Ser Ala Arg Glu Glu Glu Ala Thr Thr Gln Ile Glu Gly
50 55 60

Trp Glu Ala His Phe Glu Gly Gly

65

70

<210> 68
 <211> 41
 <212> PRT
 <213> Tolypocladium niveum

<220>
 <223> CYSA_4 Cyclosporine Synthetase Pos: 5433 to 5473

<400> 68

Thr Asn Gln Pro Leu Leu Pro Ala Gln Ser Arg Arg Ala Glu Leu Leu
 1 5 10 15

Ile Arg Glu Gly Leu Gln Thr Leu Leu Pro Pro Tyr Met Ile Pro Ser
 20 25 30

Gln Ile Thr Leu Ile Asp Arg Met Pro
 35 40

<210> 69
 <211> 76
 <212> PRT
 <213> Tolypocladium niveum

<220>
 <223> CYSA_5 Cyclosporine Synthetase Pos: 6450 to 6525

<400> 69

Gln Val Lys Ile Arg Gly His Arg Ile Glu Pro Gly Glu Val Glu Ser
 1 5 10 15

Ala Leu Leu Ser His Asn Ser Val Gln Asp Ala Ala Val Val Ile Cys
 20 25 30

Ala Pro Ala Asp Gln Asp Ser Gly Ala Glu Met Val Ala Phe Val Ala
 35 40 45

Ala Arg Asn Thr Glu Asp Glu Asp Thr Gln Glu Glu Glu Ala Val Asp
 50 55 60

Gln Val Gln Gly Trp Glu Thr His Phe Glu Thr Ala
 65 70 75

<210> 70
 <211> 40
 <212> PRT
 <213> Tolypocladium niveum

<220>
 <223> CYSA_5 Cyclosporine Synthetase Pos: 6931 to 6970

<400> 70

Asn Arg Pro Leu Asn Ser Ile Gln Ser Arg Arg Leu Gly Thr Gln Ile
 1 5 10 15

Arg Glu Lys Leu Gln Thr Leu Leu Pro Pro Tyr Met Ile Pro Ser Arg
 20 25 30

Ile Met Val Leu Asp Gln Met Pro
 35 40

<210> 71

<211> 72

<212> PRT

<213> Tolypocladium niveum

<220>

<223> CYSA_7 Cyclosporine Synthetase Pos: 9010 to 9081

<400> 71

Gln Val Lys Ile Arg Gly His Arg Ile Glu Pro Ala Glu Val Glu His
 1 5 10 15

Ala Leu Leu Gly His Asp Leu Val His Asp Ala Ala Val Val Leu Arg
 20 25 30

Lys Pro Ala Asn Gln Glu Pro Glu Met Ile Ala Phe Ile Thr Ser Gln
 35 40 45

Glu Asp Glu Thr Ile Glu Gln His Glu Ser Asn Lys Gln Val Gln Gly
 50 55 60

Trp Gly Glu His Phe Asp Val Ser
 65 70

<210> 72

<211> 41

<212> PRT

<213> Tolypocladium niveum

<220>

<223> CYSA_7 Cyclosporine Synthetase Pos: 9485 to 9525

<400> 72

Thr Asn Arg Pro Leu Gln Arg Ala Gln Ser Arg Arg Ile Glu Ser Gln
 1 5 10 15

Val Phe Glu Ala Leu Gln Thr Ala Leu Pro Ala Tyr Met Ile Pro Ser
 20 25 30

Arg Ile Ile Val Leu Pro Gln Met Pro

35

40

<210> 73
 <211> 73
 <212> PRT
 <213> Tolypocladium niveum

<220>
 <223> CYSA_8 Cyclosporine Synthetase Pos: 10501 to 10573

<400> 73

Gln Val Lys Ile Arg Gly His Arg Val Glu Pro Ala Glu Val Glu Gln
 1 5 10 15

Ala Met Leu Gly Asn Lys Ala Ile His Asp Ala Ala Val Val Val Gln
 20 25 30

Ala Val Asp Gly Gln Glu Thr Glu Met Ile Gly Phe Val Ser Met Ala
 35 40 45

Ser Asp Arg Phe Ser Glu Gly Glu Glu Glu Ile Thr Asn Gln Val Gln
 50 55 60

Glu Trp Glu Asp His Phe Glu Ser Thr
 65 70

<210> 74
 <211> 41
 <212> PRT
 <213> Tolypocladium niveum

<220>
 <223> CYSA_8 Cyclosporine Synthetase Pos: 10982 to 11022

<400> 74

Thr Ser Arg Pro Leu Gln Arg Ile Gln Asn Arg Arg Phe Glu Ser Gln
 1 5 10 15

Ile Arg Glu Gln Leu Gln Thr Leu Leu Pro Pro Tyr Met Val Pro Ser
 20 25 30

Arg Ile Val Val Leu Glu Arg Met Pro
 35 40

<210> 75
 <211> 71
 <212> PRT
 <213> Tolypocladium niveum

<220>
 <223> CYSA_10 Cyclosporine Synthetase Pos: 13068 to 13138

<400> 75

Gln Ile Lys Ile Arg Gly His Arg Ile Glu Pro Ala Glu Val Glu Gln
 1 5 10 15

Ala Leu Leu Ser Asp Ser Ser Ile Asn Asp Ala Val Val Val Ser Ala
 20 25 30

Gln Asn Lys Glu Gly Leu Glu Met Val Gly Tyr Ile Thr Thr Gln Ala
 35 40 45

Ala Gln Ser Val Asp Lys Glu Glu Ala Ser Asn Lys Val Gln Glu Trp
 50 55 60

Glu Ala His Phe Asp Ser Thr
 65 70

<210> 76

<211> 41

<212> PRT

<213> Tolypocladium niveum

<220>

<223> CYSA_10 Cyclosporine Synthetase Pos: 13549 to 13589

<400> 76

Thr Asn Arg Pro Leu His Leu Leu Gln Ser Arg Arg Leu Glu Ala Lys
 1 5 10 15

Val Arg Glu Arg Leu Gln Ser Leu Leu Pro Pro Tyr Met Ile Pro Ser
 20 25 30

Arg Ile Thr Leu Leu Asp Gln Met Pro
 35 40

<210> 77

<211> 74

<212> PRT

<213> Fusarium scirpi

<220>

<223> ESYN_2 Enniatin Synthetase Pos: 1956 to 2026

<400> 77

Gln Phe Lys Ile Arg Gly Asn Arg Ile Glu Ala Gly Glu Val Glu Ser
 1 5 10 15

Ala Met Leu Ser Leu Lys Asn Val Leu Asn Ala Ala Ile Val Arg Gly
 20 25 30

Gly Gly Glu Asp Glu Gly Pro Leu Glu Met Val Gly Phe Ile Val Ala
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35

40

45

Asp Asp Lys Asn Asp Thr Thr Glu Glu Glu Glu Thr Gly Asn Gln Val
 50 55 60

Glu Gly Trp Gln Asp His Phe Glu Ser Gly
 65 70

<210> 78

<211> 41

<212> PRT

<213> Fusarium scirpi

<220>

<223> ESYN_2 Enniatin Synthetase Pos: 2433 to 2473

<400> 78

Ala Asn Arg Pro Leu Gln Lys Leu Gln Arg Arg Arg Ala Ala Leu Gln
 1 5 10 15

Val Arg Glu Lys Leu Gln Thr Leu Val Pro Ser Tyr Met Val Pro Pro
 20 25 30

Asn Ile Val Val Leu Asp Thr Met Pro
 35 40